Registration Decision RD2018-11

Quinoxyfen

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Registration Decision Statement[1] for Quinoxyfen

Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is cancelling the registration of Quinoxyfen Technical Fungicide and Quintec Fungicide, containing the technical grade active ingredient quinoxyfen, as it meets the criteria for Track 1 substances under the Toxic Substances Management Policy (TSMP). In order to allow for the phase-out of Quinoxyfen Technical Fungicide and Quintec Fungicide for use on a variety of fruit and vegetable crops, the PMRA requires that the following implementation timelines are followed.

Date of Last Sale by Registrant: 30 June 2019

Last Date of Sale by Retailers: 30 June 2020

Last Date of Permitted Use by Users: 30 June 2021

The Proposed Registration Decision PRD2018-01, *Quinoxyfen* contains a detailed evaluation of the information submitted and a proposal for cancelling the uses of quinoxyfen on a variety of labelled crops, along with providing a three-year phase-out. Based on the information received during the public consultation, the PMRA agrees that the use of quinoxyfen is critically needed at this time for a number of fruit and vegetable crops. The three-year phase-out time proposed in PRD2018-01 will be maintained.

The interim risk mitigation measures listed in PRD2018-01 will be integrated with additional protective instructions to mitigate risks posed by use that may continue until 2021. See Appendix I for a summary of comments received during the consultation process as well as the PMRA's response to these comments.

Other Information

The relevant test data on which the decision is based (as referenced in PRD2018-01, *Quinoxyfen*) are available for public inspection, upon application, in the PMRA's Reading Room (located in Ottawa). For more information, please contact the PMRA's Pest Management Information Service by phone (1-800-267-6315) or by e-mail (hc.pmra.info-arla.sc@canada.ca).

Any person may file a notice of objection[2] regarding this registration decision within 60 days from the date of publication of this Registration Decision. For more information regarding the basis for objecting (which must be based on scientific grounds), please refer to the Pesticides section of Canada.ca (Request a Reconsideration of Decision) or contact the PMRA's Pest Management Information Service.

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1 "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

2 As per subsection 35(1) of the *Pest Control Products Act*.

Appendix I Comments and Responses

Comment 1

Twenty-one comments were received from external stakeholders, including individual growers and applicators, grower associations, provincial government organizations and the registrant, indicating their need for Quintec Fungicide, containing quinoxyfen, for the management of powdery mildew in stone fruit, grapes, strawberries, hops, and field-grown vegetables, including cucurbits. The following are the issues identified in these comments that are related to the critical need for Quintec Fungicide:

- Powdery mildew is a top concern for growers of stone fruit, including cherries, grapes, strawberries, and hops. Among registered options, Quintec Fungicide has one of the highest levels of efficacy against powdery mildew in these crops (particularly in terms of duration of effect).
- The inclusion of Quintec Fungicide in spray programs is critical to cover the long protection period required for powdery mildew management, particularly in cherry production.
- All currently available alternatives registered for powdery mildew management in the subject crops have important limitations, including restrictions in application timing, lower efficacy, and risk of phytotoxicity.
- Quintec Fungicide offers a unique mode of action that is critical to disease resistance management and to maintain the efficacy of registered alternatives, some of which pose a high risk of disease resistance development.
- Reductions in their ability to manage powdery mildew will lead to socioeconomic impact on Canadian producers and their communities.
- Cancellation of quinoxyfen will put Canadian producers at a competitive disadvantage against global competitors, particularly American growers who will still have access to this tool following cancellation in Canada.

Among these comments, the Ontario Ministry of Agriculture, Food and Rural Affairs also stated that the response to registration decisions should be graduated and measured, taking into account economic, environmental, health and social impacts.

PMRA Response:

The value of quinoxyfen and the impact of its cancellation are recognized by the PMRA. The PMRA considered the social and economic impact on growers in the context of the availability of alternatives or potential alternatives to address the loss of certain uses, as well as the long-term impact on the environment. These were the basis for proposing a three-year phase-out for quinoxyfen, rather than immediate cancellation.

Comment 2

One comment received from the Canadian Horticultural Council pointed to extensive resources that have already been allocated for the preparation of future registrations of Quintec Fungicide uses to manage powdery mildew on new sites (for example, greenhouse vegetables).

PMRA Response:

The PMRA recognizes that the preparation of data packages to support pesticide registrations represents a large investment by registrants and other organizations.

Comment 3

Comments were received from grower associations and provincial governments indicating concern that new registrations often do not keep pace with the loss of effective products due to development of resistance and/or deregistration, and that help and time is needed to develop integrated pest management (IPM) and transition strategies with regulatory support to register alternative products.

PMRA Response:

The PMRA does not initiate the registration process for new pesticide uses. New registrations are submitted by registrants, Agriculture and Agri-Food Canada (AAFC), or provincial minor use coordinators. Grower organizations are encouraged to continue to communicate and discuss their registration needs with registrants and the appropriate governmental organizations.

Comment 4

Two comments were received from organisations that outlined the importance of maintaining the existing maximum residue limits (MRLs) for residues of quinoxyfen in order to support continued importation of treated crops into Canada.

PMRA Response:

The human health risk assessment did not result in any health concerns for all segments of the population, therefore, the risk is considered to be acceptable. The PMRA will be maintaining the existing MRLs for quinoxyfen.

Comments Related to Environmental Fate – Persistence

Comments Related to Use of Terrestrial Field Dissipation Studies

Comment 5

Some commenters question whether it was appropriate for the PMRA to rely on field studies conducted outside of Canada or North America. One commenter questioned why a North American field study was not considered when European field studies were considered relevant.

PMRA Response:

Before considering the European terrestrial field dissipation (TFD) studies, the PMRA performed a crosswalk and determined that the test locations were relevant to Canada. The PMRA used the recent Ecoregion crosswalk (Organisation for Economic Cooperation and Development (OECD) 2015: ENASGIPS v.3.0), which now allows the comparison and provides guidance on the compatibility of various ecoregions in Europe and North America. Results from the comparative analysis of the European and North American ecoregions using OECD ENASGIPS v.3.0 are

included in Appendix II, Tables 1 and 2. All field studies conducted in Europe were located in ecoregions similar to one or more Canadian ecoregions and therefore, acceptable to the PMRA. Only the TFD study conducted in Central Valley grasslands, California was found not relevant to any Canadian-equivalent ecoregion. For this reason, the California TFD study was not considered relevant to Canada. It was not used for the assessment of the TSMP Track 1 persistence criteria or, like any other terrestrial field dissipation study, the risk assessment. Therefore, the California TFD study was not reported in the PRD2018-01. All the submitted European studies were found to be relevant to Canada and, therefore, equally considered by the PMRA along with the Canadian TFD study.

Comment 6

The PMRA should only use information for which they have received and reviewed all of the underlying data. The commenter specifically referred to the use of a laboratory biotransformation study using a German soil and the European TFD studies reviewed in European Commission's draft *Quinoxyfen Targeted Assessment of Potential PBT, vPvB and POP Properties*.

PMRA Response:

During the comment period, the PMRA reviewed the German aerobic soil biotransformation study and the European TFD studies conducted in Germany, France and the United Kingdom that were reviewed by the European Commission (EC). These were conducted in ecoregions relevant to Canada and were, therefore, included in the PMRA review of quinoxyfen.

German Aerobic Soil Biotransformation Study

After reviewing the aerobic biotransformation study conducted with four different German soil types, it was concluded that transformation of quinoxyfen in aerobic soil is slow. With calculated DT_{50} (dissipation time to 50% concentration) values in the range of 324 to 459 days and DT_{90} (dissipation time to 90% concentration) values in the range of 1077 to 1523 days in four different soil types (loamy sand, sandy clay loam, sandy loam and clay soils), quinoxyfen is considered to be persistent in the soil according to the Goring et al. (1975)[3] classification scheme.

This study was conducted according to the most recent standards for laboratory studies of biotransformation in aerobic soils and is considered the most reliable compared to previous laboratory studies reviewed for quinoxyfen. Therefore, it should be considered in assessing the persistence of quinoxyfen.

European Field Dissipation Studies

After reviewing these studies, it was concluded that none of the European TFD studies could be used to derive DT (dissipation time) values. In six of eight studies, quinoxyfen was applied on cropped fields followed by harvesting and replanting and could not be used to derive DT_{50}values. Although the two German field dissipation studies were conducted on bare soils, the study reports did not provide sufficient information to allow calculation of DT_{50}s. In particular, the

[3] PMRA 2037242. Goring, C.A.I., D.A. Laskowski, J.W. Hamaker and R.W. Meikle 1975. Principle of pesticide degradation in soil. In (Haque, R. and V.H. Freed, eds.) Environmental dynamics of pesticides. Plenum Press, New York, pp. 135–172.

application rates were not verified and no information could allow for conversion from measured soil concentration (mg a.i./kg soil) to application rate in g a.i./ha in soil profile. However, the fact that 1.5 to 2 years after a single application at 400 g a.i./ha (<2/3 of maximum Canadian application rate of 625 g a.i./ha), there were 26 to 33% of quinoxyfen remained in the German bare soil TFD sites and quantifiable residues remained in all cropped TFD fields provide supporting evidence that quinoxyfen is persistent under field conditions.

Although DT_{50} values are not valid, the PMRA concluded that there was sufficient evidence that quinoxyfen is persistent. Significant carryover (>30%)[4] of quinoxyfen was observed in soil to the following growing season.

Comments Related to Accumulation in the Environment Over Time (Monitoring Study)

Comment 7

Thetwo-year European exposure and biota studies and the 5-year terrestrial field accumulation studies were conducted in ecoregions relevant to Canada and show that quinoxyfen residues are not expected to build-up to unacceptable levels in aquatic ecosystems over a multi-year timescale in Canadian conditions.

PMRA Response:

The PMRA reviewed the 2-year European exposure and biota studies and the 5-year terrestrial field accumulation studies and concluded the following:

These studies were conducted in ecoregions relevant to Canada and were therefore considered in the assessment.

The PMRA also came to the following conclusions:

In the case of the 2-year European field and biota exposure studies, the magnitude of residues measured in the subsequent year (i.e. approximately one year apart) showed that quinoxyfen was relatively persistent in the German site as evidenced by very little decline in residues during this period (in some cases, close to 100% carryover). However, in the Italian site, results were inconsistent at different monitoring locations and, thus, it is difficult to conclude whether residues are accumulating over time.

In the case of the soil accumulation studies, data were monitored during five consecutive years of quinoxyfen use under operational field conditions in France, United Kingdom and Germany, where quinoxyfen was applied once or twice annually, in the spring or early summer. The magnitude of residues one week after treatment in the first year compared to that before treatment in subsequent year, i.e., approximately one year apart, are of most interest. At all sites, quinoxyfen appears to persist as evidenced by very little decline in residues in between applications and has significant carryover year-to-year.

[4] A half-life of approximately 6 months (180 days) results in an annual residue of about 30% remaining in the field until the following annual application or growing season. A greater half-life would result in increasing annual residues in the field.

Overall, considering all the information obtained from the TFD studies, monitoring and accumulation studies and based on the weight-of-evidence approach, the PMRA concluded that quinoxyfen is persistent in soil.

Comment 8:

One commenter disagreed with how the information from the terrestrial field dissipation (TFD) studies was integrated. Pesticide dissipation may proceed at different rates under field conditions and may result in degradates forming at different levels from those in a laboratory study. The terrestrial field dissipation study can provide a mechanism for testing and refining a hypothesis for the environmental fate and transport of a pesticide under actual use conditions. Thus, the TFD studies are more suitable than laboratory data to assess persistence. Additionally, in the decision-making process, the PMRA could have evaluated the DT_{50} values by considering all DT_{50}s relevant to assessing persistence (not just those values exceeding the criteria).

PMRA Response:

As described in PRD2018-01, Section 6.1, p. 15–16, to assess the persistence criteria, field studies are traditionally preferred over laboratory studies, as they reflect more realistic conditions of use of a pesticide and consider all potential routes of transformation. As per the North American Free Trade Agreement guidance for TFD studies:

"It may be possible, in some instances, to replace the route-specific model inputs with a combined dissipation rate determined in a field study under the following conditions:

- The weight of laboratory and field evidence indicates that dissipation in the field can be confidently attributed solely to degradation/transformation (i.e., negligible loss by the other dissipation routes, such as leaching, runoff, volatilization and plant uptake)."

In the case of quinoxyfen, dissipation in the field cannot be confidently attributed solely to degradation. Abiotic and biotic degradation of quinoxyfen individual results from laboratory studies taken together, tend to indicate that quinoxyfen would be persistent in soil (is not volatile, does not hydrolyze, photolysis is not a major route of transformation). Under laboratory condition, 9/10 half-lives and the average of all half-lives reported for the aerobic biotransformation studies exceeded the persistence criteria.

Although the Ontario TFD study showed quinoxyfen dissipation rate does not meet the persistence criterion, the rate declined considerably over time. The shorter DT_{50}s did not show more degradation as the transformation products did not appear to be present at higher concentrations than in laboratory studies; it is therefore uncertain whether dissipation can be solely attributed to biotic and abiotic degradation processes. Furthermore, in the laboratory study using the same soil, quinoxyfen had an aerobic half-life of 263 days.

The European TFD studies reported in PRD2018-01 have been reviewed and found to be unacceptable for determining quantitative DT_{50} values. However, they all showed significant residues being carried over year-to-year. The other field studies (exposure monitoring and soil accumulation studies) also showed evidence of persistence and carryover year-to-year.

The PMRA concluded that except for the Ontario TFD study, all the other field studies were either inconclusive or provided insufficient information to supersede the laboratory information. The PMRA relied on a weight of evidence approach that showed laboratory DT_{50}s exceeded the cut-off criteria and all but one field study indicated that quinoxyfen was persistent. One study in Ontario cannot supersede this weight of evidence. Especially when we are not confident that dissipation was solely a result of degradation.

Please see revised text to the PRD2018-01 text in Appendix II.

Comments on the Bioaccumulation Assessment Presented in PRD2018-01

Log K_{ow}

Comment 9

The estimated Log K_{ow} for quinoxfen generated using KOWWIN should be replaced with the laboratory generated Log K_{ow} of 4.66.

PMRA Response:

The PMRA used the following guidance specific to assessing persistence and bioaccumulation under the Government of Canada's Toxic Substances Management Policy – Persistence and Bioaccumulation Criteria (Environment Canada, 1995).[5]

"The potential for a substance to bioaccumulate can be expressed in terms of the bioconcentration factor (BCF), the bioaccumulation factor (BAF) or, for lipophilic substances, the octanol-water partition coefficient (K_{ow}). BCF and BAF are environmentally more relevant than K_{ow} because they take into account the response of the organism, including metabolism, steric effects at the gill/water interface, etc. In addition, bioavailability of the substance is considered, especially for BAF. Field data (for example, BAFs) are preferred over laboratory data (for example, BCFs) which, in turn, are preferred over chemical properties (for example, log K_{ow}). However, in terms of measurement, standardization, reliability of estimates (range) and availability of data, the reverse order is more practical. The ad hoc Science Group recommends the use of BCF over log K_{ow} because of its greater environmental relevance."

The PMRA included all available criteria to estimate the potential for bioaccumulation of quinoxyfen and assessed them as described above. Although the KOWWIN values were reported, the PMRA relied primarily on the laboratory BCF values to assess quinoxyfen against the bioaccumulation criterion since these were both reliable and more environmentally relevant than the log K_{ow} estimates. No amendments to the PRD2018-01 are required.

5 Environment Canada. 1995. Toxic Substances Management Policy – Persistence and Bioaccumulation Criteria. Final Report of the ad hoc Science Group on Criteria. Ottawa, ON, Canada. No. En40-499/1-1995. 26 p.

BCF Studies

Comment 1

In PRD2018-01, the PMRA only relied on laboratory BCF studies to assess the potential for bioaccumulation of quinoxyfen. BAFs, depurations rates and field studies should have been used in the PMRA assessment of bioaccumulation and TSMP.

Why did the PMRA conclude in ERC2013-02 that quinoxyfen does not meet all Track 1 criteria and is not considered a Track 1 substance. Specifically regarding bioaccumulation, it was originally concluded that although quinoxyfen bioconcentrated in fish with BCFs > 5000, rapid depuration rates and field studies indicate that significant bioaccumulation under field conditions is unlikely. However, in PRD2018-01, the PMRA concludes that quinoxyfen meets the criteria for a Track 1 substance based on the bioaccumulation value for quinoxyfen (BCF>5000).

PMRA Response:

In PRD2018-01, the PMRA considered both laboratory and field data in its assessment of bioaccumulation under the TSMP. Under the TSMP, field BAFs are preferred over laboratory BCFs as they take into account exposure from all sources (water, food), bioavailability and interactions under environmentally-relevant conditions. Insufficient information was provided to calculate BAFs under field conditions. Therefore, the PMRA relied primarily on the BCF studies.

In ERC2013-02, one BCF study was reviewed by the PMRA against the OECD BCF guidance from 1996.[6] As reported in PRD2018-01 on p. 12, two BCF studies were reviewed, including the one initially reviewed in ERC2013-02. The PMRA analyzed both bioaccumulation studies using the 2012[7] OECD guideline for assessing bioaccumulation. The 2012 guidance considers biological factors such as growth and fish lipid content which can have a strong impact on the bioaccumulation results.

The size of the fish[8] and their metabolic rate had an impact on the study results. From these recalculations, the PMRA confirms that the smaller sized fish in the original study likely contributed to the determination of lower BCFs compared to the second study conducted with larger fish. The smaller fish likely had a much faster metabolic rate resulting in quicker depuration; this is evident in the half-lives calculated for both studies (4.1 and 2.8 days for small fish versus 32.1 days for larger fish when corrected for growth (BCF study 2)).

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6 OECD (1996), *Test No. 305: Bioconcentration: Flow-through Fish Test*, OECD Guidelines for the Testing of Chemicals, Section 3, No. 305, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264070462-en.

7 OECD (2012), *Test No. 305: Bioaccumulation in Fish: Aqueous and Dietary Exposure*, OECD Guidelines for the Testing of Chemicals, Section 3, No. 305, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264185296-en.

8 From the 2012 OECD guidance (para. 123): *Fish within the recommended size/weight range (cf. Annex 3) should be used...Species tested during a life-stage with rapid growth can complicate data interpretation, and high growth rates can influence the calculation of assimilation efficiency* (For rapid growth during the uptake phase, the true feeding rate will decrease below that set at the beginning of exposure.)

Although the fish were smaller than recommended by the OECD 305, this was integrated in the kinetic calculations corrected for growth and lipids. No amendments to the PRD2018-01 are required.Further details regarding the PMRA assessment of bioaccumulation are described below:

BCF Study 1

As a result of the analysis conducted by the PMRA for PRD2018-01, the results reported in ERC2013-02 were determined to be incorrect. The results were described as reported by the study authors, however, the model used by the study authors could not be validated by the PMRA and the pooling of the data from low and high exposures was found to be inappropriate. These issues were resolved by re-analyzing the raw data and using the updated calculation methods following the new BCF guideline requirements from OECD 305 (2012). Although fish were smaller than the OECD 305 recommended size, the updated calculation methods corrected the BCF value for the increased growth rate expected in smaller fish. With these calculation adjustments, the study was found to be scientifically valid and was classified as acceptable and satisfies the guideline requirement for a laboratory bioconcentration study in fish.

The results indicate that fish bioconcentrate quinoxyfen exceedingly well. The BCF_{kg}[9] are considered to be the most accurate as they are corrected for growth and lipid and would have adjusted the results to account for the small fish size (i.e., increased growth rate). The new BCF values are 9656 and 7379 in the low and high exposure studies, respectively. These are approximately double or 50% greater than the 5040 value reported in ERC2013-02.

BCF Study 2

The purpose of this study was to determine the bioconcentration potential of the fungicide quinoxyfen in tissues of three representative species of differing trophic levels, namely algae (*Pseudokirchneriella subcapitata*), daphnid (*Daphnia magna*), and rainbow trout (*Oncorhynchus mykiss*). A secondary purpose of the study was to monitor the formation of metabolites, if any, in rainbow trout. No recognized test guidelines are available to assess the bioconcentration of chemicals in algae or Daphnia species. There are also no set TSMP BCF criteria for these species. Thus, for the purpose of this review, the experiments with algae and Daphnia species are not reported further.

Rainbow trout were exposed to an aqueous test solution of ^{14}C-quinoxyfen at a mean measured concentration of 4.43 ng quinoxyfen/mL dilution water. The test was conducted under flow-through conditions with a 35-day exposure period, followed by an 85-day elimination (depuration) period.

The results indicate that quinoxyfen undergoes little to no metabolism in rainbow trout over the study period. Based on the time water average exposure concentration of quinoxyfen in water and the mean measured concentration in whole fish for the three steady state sample days, the BCF calculated at steady state (BCF_{ss}) is 8673.

9 standardized kinetic value reflecting theoretical bioconcentration at steady state, corrected for the growth rate of fish over the experiment and, lipid content normalized at 5%.

The study author's methodology for calculating a kinetic BCF (BCF_k) metrics could not be validated given the information in the study report; therefore, the PMRA recalculated BCF_k following the current OECD 305 guidelines (OECD 2012) including calculation of the time weighted average (TWA) of quinoxyfen in water, determination of growth rate and correction for growth and lipid.

There was a significant difference (slope comparison test) in growth in the test fish during the uptake and depuration phases; therefore, the growth data from the depuration phase was used to correct the BCF_k for growth. The growth rate (kg) during the depuration phase was 0.014/day. Lipid was determined to be 10% and was used to lipid correct the BCF_k and normalize to 5%.

Sequentially determining k_2 and then k_1 using non-linear regression resulted in the best fit without any data transformation.

The BCF_k, the kinetic BCF corrected for growth (BCF_{kg}), the kinetic BCF corrected for lipid content (BCF_{kl}) and the kinetic BCF corrected for growth and lipid (BCF_{kgl}) were 13 553, 22 333, 6761 and 11 141, respectively. The $t_{1/2}$ and growth corrected $t_{1/2}$, determined from the depuration constant are 19.5 and 32.1 days, respectively.

The results indicate that fish bioconcentrate quinoxyfen exceedingly well. The BCF_{kgl} of 11 141 is considered to be the most accurate as it is corrected for growth and lipid.

Comment 11

Inclusion of depuration rates in a bioaccumulation assessment is critical in circumstances where only BCFs are available as BCFs used in isolation are a poor indicator of the potential of bioaccumulation in the environment. Studies demonstrated that once fish are removed to clean water, depuration of quinoxyfen from the tissues was rapid with a modelled elimination half-life of 2.7 days, with residues no longer detected in fish after 10 days in the clearance phase.

PMRA Response:

The depuration rates reported by the commenter and by the PMRA in ERC2013-02 were determined to be erroneous. As explained in a previous response, the more reliable depuration rate was estimated to be 32.1 days in the study that used appropriately sized fish and values corrected for growth.

The PMRA agrees with the commenter that depuration rates are important in determining bioaccumulation. Depuration rates were used in the current PMRA assessment. This was incorporated in the PMRA assessment through applying the current international approach to estimating kinetic BCFs (according to the 2012 OECD guidance) which includes the calculation of uptake and depuration constants to derive kinetic BCFs. The kinetic BCF values are reported in PRD2018-01. No amendments to the PRD2018-01 are required.

Bioaccumulation Under Field Conditions (BAFs)

Comment 12

The PMRA should include the calculation of BAFs within their assessment.

PMRA Response:

The 2-year monitoring studies from Europe performed in Canadian-equivalent ecoregions were examined. Although quinoxyfen was detected and quantified in some invertebrates and in fish in regions where quinoxyfen was used, as quinoxyfen concentrations in water were not reported/measured and quinoxyfen concentrations in sediment were generally low, bioaccumulation (BAFs) could not be quantified. The monitoring data were considered not reliable enough to assess bioaccumulation under field conditions; it was therefore concluded that there was insufficient information provided to calculate BAFs under field conditions. Therefore, the PMRA relied primarily on the BCF values. No amendments to the PRD2018-01 are required.

Food chain modelling

Comment 13

A study was submitted reporting on a time-dependent bioaccumulation model of quinoxyfen through a freshwater pelagic aquatic food chain

PMRA Response:

The PMRA has considered the submitted report. The PMRA has a number of concerns regarding the relevancy associated with assessing the TSMP bioaccumulation criteria using modelled food chain data.

The PMRA's reliance on empirical data to properly assess whether a pesticide meets any of the Track 1, TSMP criteria is of primary importance. Generally, an assessment of bioaccumulation potential begins with lower tier evidence such as the log K_{ow}, and moving towards higher tier evidence such as BCF studies conducted in the laboratory and eventually, if available, BAF studies from biota/water concentrations determined in field studies or monitoring studies. This study relies entirely on modelled values designed around input parameters of physico-chemical properties, and fate characteristics obtained from laboratory studies.

Concerns specific to the model input parameters:

- The model was run using a single application rate at 10 g a.i./ha. Quinoxyfen is registered at much higher application rates in Canada (75 g a.i/ha with a potential maximum of five applications for use on grapes, and a maximum application rate of 125 g a.i./ha with a potential maximum of five applications on stone fruit). A 25 m buffer zone was also used in the model, whereas buffer zones on the current Canadian label range from one to 20 m, depending on the use; a 15 m buffer zone is prescribed for an early application of a maximum of 75 g a.i./ha on grape. The modelling results, therefore, are not considered representative of the Canadian use pattern.

- The input parameters did not consider that the PMRA analyzed the same studies against the current OECD guideline and corrected calculations where appropriate.

- The model considered BCF values for daphnia and algae. According the Government of Canada's Toxic Substances Management Policy – Persistence and Bioaccumulation Criteria (Environment Canada, 1995)[10] the critical BCF value was derived from BCFs for freshwater fish. Other organisms could be used but only with appropriate expert judgement. No justification was given to use the BCFs derived from these species. Additionally, according to SCHER (2011),[11] BCF studies conducted using invertebrates and algae "are of poor predictability, as adsorption in small organisms is higher by body weight and the resultant BCF values do not reflect bioconcentration only". Hence, the uncertainty from using results for these organisms in the model is significant.

- The maximum EEC of quinoxyfen in water estimated by the model using a near-field scenario was 0.00294 µg/L. This value was significantly less than 0.0045 µg/L reported in an environmental monitoring program conducted far-field in the Baltic Sea.[12]

- Finally, the study authors report that the modelling results are similar to those observed under field conditions. However, this also did not consider that the PMRA found that the European monitoring studies were not acceptable for determination of field BAFs and food chain bioaccumulation.

Based on the above considerations, the modelling study was considered of low value in assessing the bioaccumulation potential of quinoxyfen. This study does not affect the previous outcome determined by the PMRA; the BCF studies are considered the most reliable information provided regarding the bioaccumulation potential of quinoxyfen. No amendments to the PRD2018-01 are required.

Comments on the Consultation Process

Comment 14

Several commenters questioned why the publication of PRD2018-01 was the first opportunity for stakeholders to comment on the proposed registration decision for quinoxyfen.

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10 Environment Canada. 1995. Toxic Substances Management Policy – Persistence and Bioaccumulation Criteria. Final Report of the ad hoc Science Group on Criteria. Ottawa, ON, Canada. No. En40-499/1-1995. 26 p.

11 Scientific Committee on Health and Environmental Risks (SCHER). 2011. Opinion on 'Chemicals and the Water Framework Directive: Draft Environmental Quality Standards' for Quinoxyfen. Adopted opinion on 15 June 2011

12 PMRA 2825590. ICES, 2015. ICES Data Portal, last consulted on 18 April 2017. http://ecosystemdata.ices.dk/inventory/index.aspx?LatN=&LatS=&LonE=&LonW=&Sdate=&Filter=quinoxyfen&Edate=&Area=Parameter&Param=0

PMRA Response:

Quinoxyfen was a conditional registration. Where public consultation was required for a conditionallyregistered product – as per the Regulations that pertained to conditional registrations – this consultation was deferred until the registrant applied for either a renewal or a conversion of that conditional registration, whichever came first.[13] In this case the registrant applied for a conversion by submitting all of the data that the PMRA had required under section 12 of the *Pest Control Products Act*. The PMRA reviewed all of these data and any other relevant available information as part of its evaluation, which was the subject of this public consultation.

Comment 15

Why did the PMRA not notify the registrant of the PMRA's intention to consult with Environment and Climate Change Canada (ECCC) and why did the consultation with ECCC occur prior to consultation with the registrant and outside of the public consultation process, which is at odds with Section 28 of the *Pest Control Products Act*. The PMRA did not follow procedural fairness as understood by the commenter, specifically with respect to consultation with other government bodies.

PMRA Response:

As part of a robust assessment (due diligence) of a submission, the PMRA may involve ECCC or other government bodies during the course of an evaluation to discuss its technical and scientific analysis with regards to risks to human health or the environment, including TSMP. Such discussion does not relate to a completed evaluation and proposed registration decision, and is therefore not a consultation as set out in section 28 of the *Pest Control Products Act*. It is important to note that while the PMRA asked ECCC to comment on the PMRA's analysis with regards to TSMP, the risk assessment and proposed registration decision (of which the TSMP analysis forms a part) was conducted by the PMRA.

The outcome of the PMRA's assessment (i.e., a summary of the completed evaluation report and the proposed registration decision), including its conclusion on TSMP, was available for public consultation as PRD2018-01.

Comment 16

The PMRA did not follow procedural fairness as understood by the commenter. Specifically, the PMRA should have followed a consultation process similar to one used by re-evaluation program. Specifically, the consultation should have:

- taken into account economic, environmental, health and social impacts;
- included grower groups, registrants, governments and researchers
- included the review of additional data;

13 See ERC2013-02, page 6 under "Other Information".

- developing transition strategies,
- providing regulatory support to register alternative products; and
- working with stakeholders to implement mitigation.

PMRA Response:

Although socio-economic factors are not considered when setting the ultimate goal of virtual elimination under DIR99-03, the TSMP does recognize that social, economic and technical considerations must be taken into account in any management decision. Therefore, the virtual elimination of Track 1 substances is a long-term goal to be implemented under TSMP. The PMRA considered the social and economic impact on growers, including the availability of alternatives or potential alternatives to address the loss of certain uses, as well as the long-term impact on the environment. These were the basis for proposing a three-year phase-out for quinoxyfen, rather than immediate cancellation.

The outcome of the risk assessment, including the PMRA's conclusions with regards to TSMP were available for public consultation and all stakeholders, including those listed above, were given the opportunity to provide comments to the PMRA for consideration before the PMRA made its final decision. In addition, the PMRA reviewed all additional data that was submitted during the course of the public consultation before coming to its final decision as reflected in this registration decision document.

Comment 17

Why was the registrant not informed that the PMRA had made significant changes to their assessment of quinoxyfen as it related to bioaccumulation and persistence, and why were they not given the opportunity to respond prior to the publication of PRD2018-01.

PMRA Response:

The TSMP assessment in ERC2013-02 was considered preliminary and was described as such (p. 28). The PMRA notified the registrant that quinoxyfen meets the TSMP Track 1 criteria in September 2017. The publication of PRD2018-01 was January 2018.

Comments Related to the TSMP Assessment

Related to TSMP Being an Outdated Policy

Comment 18

The registrant also has concerns that the PMRA, in applying the TSMP, is relying on an outdated policy that in practice is no longer used by the ECCC. In this respect, the registrant notes that in 2006 the ECCC implemented the Chemical Management Plan ("CMP") that in substance has replaced evaluations performed under the TSMP The CMP provides for a more extensive review and consultation than structures under the TSMP, including an increased emphasis on risk management in lieu of virtual elimination.

PMRA Response:

The PMRA is mandated, under section 7(8) of the *Pest Control Products Act*, to give effect to TSMP:

> "In evaluating the health and environmental risks and the value of a pest control product, the Minister shall give effect to government policy."

Government policy under the *Pest Control Products Act* is defined as, "the Toxic Substances Management Policy issued by the Government of Canada in June, 1995, as long as it remains in effect, and any other policies of the Government of Canada that are prescribed."

The Toxic Substances Management Policy remains in effect and can be found at the following web address: http://publications.gc.ca/collections/Collection/En40-499-1-1995E.pdf.

The PMRA implements TSMP through Regulatory Directive Dir 99-03 (DIR99-03, The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy).

Integration of All TSMP Information

Comment 19

One commenter noted that the TSMP is not solely a hazard-based assessment. Information on persistence and bioaccumulation is integrated to indicate higher exposure in the longer term. The assessment should have included depuration, biotic and abiotic degradation, dissipation mechanisms, coupled with field scale trial to understand behaviour of quinoxyfen. In PRD2018-01 the PMRA's assessment on persistence and bioaccumulation was based on laboratory data only; it appeared the PMRA did not make an effort to include TFD, exposure, environmental fate or monitoring studies into the equation, critical factors needed to conduct a more refined assessment. The use of laboratory data as a sole source of information to make a regulatory proposal led to the premature and biased decision of proposing to cancel quinoxyfen's registration.

PMRA Response:

The PMRA agrees that the TSMP is not solely hazard-based. The PMRA did consider abiotic, biotic degradation and dissipation mechanisms coupled with field scale information in assessing the behaviour of quinoxyfen in the environment. The PMRA disagrees with the commenter regarding the conclusion of the individual studies and how these should be integrated and used to come to a TSMP conclusion. As mentioned previously, the PMRA concluded that field studies, except the Ontario TFD study, all the other field studies were either inconclusive or provided insufficient information to calculate a field DT_{50} that could supersede the laboratory information. For that reason, many of the laboratory studies were found to be more relevant/reliable than the field studies. The PMRA relied on a weight of evidence approach that showed laboratory DT_{50}s exceeded the cut-off criteria and all but one field study indicated that quinoxyfen was persistent. One study in Ontario cannot supersede this weight of evidence. Especially when we are not confident that dissipation was solely a result of degradation

With respect to bioaccumulation, the PMRA notes that the original depuration estimates for quinoxyfen were likely overestimated. The smaller fish likely had a much faster metabolic rate resulting in quicker depuration; the depuration rate for the second BCF study, where the fish size met the guideline requirement and were corrected for growth, was 32.1 days. Residues in whole fish sampled on clearance day 85 were 2403 ng a.i./g ww (wet weight), about 6% of the maximum concentration in fish at steady state. All radioactivity in the fish was attributed to quinoxyfen. The results indicate that quinoxyfen underwent little to no metabolism in rainbow trout over the study period. The revised depuration rate is more reflective of the BCF values obtained in both bioaccumulation studies.

The monitoring data were considered not reliable to assess bioaccumulation under field conditions. The PMRA notes that the original depuration estimates for quinoxyfen were likely overestimated because of the small fish size and because estimates not corrected for growth.

Comment 20

The *Pest Control Products Act* requires that the PMRA take a risk-based approach to assessing pesticides. Why has the PMRA applied a hazard-based approach to assessing quinoxyfen under the TSMP?

PMRA Response:

The environmental risk assessment conducted by the PMRA addresses the intermediate-term risks posed by the field uses of quinoxyfen. The environmental risk assessment and mitigation measures do not address the potential long-term risk posed by persistent and bioaccumulative substances.

A substance is considered a Track 1 substance when it meets a combination of critical values for common characteristics of chemicals known to have the greatest potential impact on the health of ecosystems, including humans over the **long-term**. As these substances accumulate in the environment and organisms over time, science cannot always accurately predict the effects that a substance will have on the environment or human health. A preventative and precautionary approach is, therefore, taken for assessing the potential long-term risk from these substances.

Comments Related to Registration Practices and Procedures

Comment 21

The PMRA has not followed its usual practices and procedures for reviewing registrations. Trifluralin (PRVD2008-22) and Pendimethalin (PRVD2007-07) were cited as examples of where a different (risk-based) assessment approach was taken.

- ***"Trifluralin** meets three of four criteria for inclusion as a TSMP Track 1 substance (persistence, anthropogenic and Canadian Environmental Protection Act toxic [CEPA- toxic]). However, the PMRA has not made a final determination of the status of trifluralin under the TSMP at this time due to uncertainties with the fourth criteria, bioacccumulation. Additional field data addressing bioaccumulation, especially in the upper food chains, are required to complete this assessment." (PMRA, PRVD2008-22)*

- *"The PMRA has concluded that **pendimethalin** does not meet the TSMP Track 1 criteria for bioaccumulation because there is no credible field evidence indicating that the criteria for bioaccumulation (BAF 5000) has been met, nor that there is biomagnification in biota inhabiting the areas of use. It is therefore concluded that pendimethalin does not meet the criteria for a Track 1 substance under the TSMP. Pendimethalin is nevertheless considered a PBT substance." (PMRA, RVD2008-23)*

PMRA Response:

When reviewing quinoxyfen, the PMRA used the following guidance for assessing persistence and bioaccumulation under the Government of Canada's Toxic Substances Management Policy – Persistence and Bioaccumulation Criteria (Environment Canada, 1995)[14]. Specifically regarding how information related to bioaccumulation was considered, the following guidance was followed:

> "The potential for a substance to bioaccumulate can be expressed in terms of the bioconcentration factor (BCF), the bioaccumulation factor (BAF) or, for lipophilic substances, the octanol-water partition coefficient (K_{ow}). BCF and BAF are environmentally more relevant than K_{ow} because they take into account the response of the organism, including metabolism, steric effects at the gill/water interface, etc. In addition, bioavailability of the substance is considered, especially for BAF. Field data (for example, BAFs) are preferred over laboratory data (for example, BCFs) which, in turn, are preferred over chemical properties (for example, log K_{ow}). However, in terms of measurement, standardization, reliability of estimates (range) and availability of data, the reverse order is more practical."

In PRD2018-01, the PMRA considered both laboratory and field data in its assessment of bioaccumulation under the TSMP. Under the TSMP, field BAFs are preferred over laboratory BCFs as they take into account exposure from all sources (water, food), bioavailability and interactions under environmentally-relevant conditions. Insufficient field and monitoring data were provided to show quinoxyfen does not bioaccumulate under field conditions. Therefore, the PMRA relied primarily on the laboratory studies which showed that quinoxyfen bioaccumulates significantly in organisms.

Consideration of Monitoring Data in the TSMP Assessment

Comment 22

The BC Tree Fruits Cooperative noted their cooperative participated in a 2017 waterway monitoring study conducted in BC. They stated that quinoxyfen was not found in water testing of creeks, rivers and streams surrounding their orchard growing areas.

PMRA Response:

The study referred to by the commenter was not provided to the PMRA.

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14 Environment Canada. 1995. Toxic Substances Management Policy – Persistence and Bioaccumulation Criteria. Final Report of the ad hoc Science Group on Criteria. Ottawa, ON, Canada. No. En40-499/1-1995. 26 p.

The information provided does not address the long-term risk posed by persistent and bioaccumulative substances as assessed under the TSMP. The TSMP criteria are a combination of critical values for common characteristics of chemicals known to have the greatest potential impact on the health of ecosystems, including humans over the long-term. Given that the information provided does not impact the assessment of quinoxyfen against these criteria (i.e., persistent and bioaccumulative properties of quinoxyfen), no modifications to TSMP assessment were made.

Comment 23

It was suggested that a robust environmental monitoring program should be implemented in order to determine the impact mitigation has upon aquatic biota. This would enable a regulatory decision that is evidence-based and draws upon real world situations rather than mere modelling and laboratory studies.

PMRA Response:

All known Canadian monitoring data were reported in ERC2013-01 and the PRD2018-01. The commenter did not provide any additional monitoring data. No amendments are required.

Comments Related to the Implementation of the TSMP

Comment 24

There is a lack of transparency in how the PMRA is implementing the TSMP.

PMRA Response:

The PMRA is required under the *Pest Control Products Act* to give effect to the TSMP when evaluating the risks and value of the pesticide that is the subject of the application. The PMRA implements the principles of TSMP as outlined in the Regulatory Directive "DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*". The PMRA used the following guidance specific to assessing persistence and bioaccumulation under the Government of Canada's Toxic Substances Management Policy: "Persistence and Bioaccumulation Criteria" (Environment Canada, 1995).[15]

15 Environment Canada. 1995. Toxic Substances Management Policy – Persistence and Bioaccumulation Criteria. Final Report of the ad hoc Science Group on Criteria. Ottawa, ON, Canada. No. En40-499/1-1995. 26 p.

Consideration of Risk Assessment in the TSMP Assessment

Comment 25

The PMRA has applied basic screening processes to assess quinoxyfen with respect to the criteria for Track 1 TSMP classification and has, thus, ignored their own risk assessment outcomes presented in PRD2018-01, which found no significant concerns related to aquatic environments that cannot be managed through risk mitigation measures. The PMRA should review the TSMP implementation and incorporate persistence and bioaccumulation into the environmental risk assessment.

The commenter does not agree with the implementation of the TSMP into the pesticide registration process, as it does not align with the PMRA's risk management approach. Hazard assessments cannot be the only basis for regulatory decisions as it contradicts the PMRA's mandate to make sound registration decisions applying modern and rigorous hazard and risk assessments methods.

PMRA Response:

The environmental risk assessment conducted by the PMRA addresses the intermediate-term risks posed by the field uses of quinoxyfen. The environmental risk assessment and mitigation measures do not address the potential long-term risk posed by persistent and bioaccumulative substances.

The TSMP provides decision makers with direction and sets out a science-based management framework to ensure that federal programs are consistent with its objectives. It also serves as the centrepiece of the federal government's position on the management of toxic substances in discussions with the provinces and territories and negotiations with the world community.

A substance is considered a Track 1 substance when it meets a combination of critical values for common characteristics of chemicals known to have the greatest potential impact on the health of ecosystems, including humans over the **long-term**. As these substances accumulate in the environment and organisms over time, science cannot always accurately predict the effects that a substance will have on the environment or human health. A preventative and precautionary approach is therefore taken for assessing the potential long-term risk from these substances.

A substance is considered a Track 1 substance when it meets a combination of critical values for common characteristics of chemicals known to have the greatest potential impact on the health of ecosystems, including humans over the **long-term**. As these substances accumulate in the environment and organisms over time, science cannot always accurately predict the effects that it will have on the environment or human health. A preventative and precautionary approach is therefore taken for assessing the potential long-term risks from these substances.

Comment 26

Commenters noted that the crops on the Quintec Fungicide label are grown on well-drained soil, thus there would be minimal movement to off-site water bodies.

PMRA Response:

The environmental risk assessment conducted by the PMRA and the mitigation measures address the relatively short-term risks posed by the field uses of quinoxyfen. The environmental risk assessment and mitigation measures do not address the long-term risk posed by persistent and bioaccumulative substances as assessed under the TSMP. The TSMP criteria are a combination of critical values for common characteristics of chemicals known to have the greatest potential impact on the health of ecosystems, including humans over the long-term. Given that the information provided does not impact the assessment of quinoxyfen against the criteria these criteria (i.e., persistent and bioaccumulative properties of quinoxyfen), no modifications to TSMP assessment were made.

Considerations of Risk Mitigation Measures in the TSMP Assessment

Comment 27

It was of the opinion of several commenters that it is highly unlikely that quinoxyfen would enter the aquatic environment and cause risk to aquatic organisms for the following reasons:

- quinoxyfen is persistent and tightly bound to the soil. Therefore, when applied on land, it is highly unlikely to move to water and come into contact with the aquatic environment;
- the use instructions on the label and the buffer zones prevent the exposure of aquatic systems;

Several commenters also requested that the aquatic risk assessment and buffer zones be evaluated using airblast spraying application methods and current Quintec Fungicide label instructions. If the current use conditions are considered, the risks to the aquatic environment would be acceptable.

One commenter also suggested that vegetative buffer strips could be required to further prevent quinoxyfen from entering aquatic systems.

PMRA Response:

The aquatic risk assessment is reported in ERC2013-01, p. 23 to 25 and updated in the PRD2018-01; the risk did not exceed the level of concern. The precautionary label statements and buffer zones on the current Quintec label were required as a result this risk assessment.

The environmental risk assessment conducted by the PMRA and the mitigation measures address the risks posed by the field uses of quinoxyfen and included examining the risk posed by airblast spraying applications. The environmental risk assessment and mitigation measures do not address the long-term risk posed by persistent and bioaccumulative substances as assessed under the TSMP. The TSMP criteria are a combination of critical values for common characteristics of chemicals known to have the greatest potential impact on the health of ecosystems, including humans over the long-term. Given that the information provided does not impact the assessment of quinoxyfen against the criteria these criteria (i.e., persistent and bioaccumulative properties of quinoxyfen), no modifications to TSMP assessment were made.

Implementation of Risk Mitigation Measures to Reduce Environmental Exposure

Comment 28

Multiple comments were received stating a willingness to impose additional mitigation measures on the label in order to reduce environmental exposure and, thus, allow for continued registration of Quintec Fungicide. Additional mitigation suggested included: use of additives to increase droplet size, nozzle selection, lower pressure and boom height, installing shields or shrouds and/or using tunnel sprayers, using buffer zones and/or vegetative filter strips, and avoiding spraying in adverse weather conditions, restricting use to greenhouses. Comments proposed that additional potential mitigation measures are available and were not properly considered within PRD2018-01. It was requested that the PMRA works with grower groups to implement additional mitigation actions to reduce potential environmental risks from quinoxyfen exposure.

PMRA Response:

The risk mitigation measures reduce short-term risk to the environment, but do not address the long-term risks associated with substances that are persistent and bioaccumulative. This information does not impact the Track 1 conclusion.

Comment 29

The fact that very little quinoxyfen is used in Canada and thus released to the environment, should be considered in the TSMP assessment.

PMRA Response:

Reduced environmental exposure affects the short-term risk to the environment, but does not address the long-term risks associated with substances that are persistent and bioaccumulative. This information does not impact the Track 1 conclusion.

Considerations of Risk Mitigation Measures in the TSMP Assessment-Greenhouse Uses

Comment 30

Two commenters noted that use of quinoxyfen within a greenhouse scenario would result in minimal to no soil application, minimal opportunity for quinoxyfen to reach the environment. It was also noted that quinoxyfen is non-toxic to non-target arthropods (honey bees, mites and wasps) which are used in greenhouses for pollination. These comments were in support of future potential registrations of quinoxyfen on greenhouse crops.

PMRA Response:

Quintec Fungicide is not currently registered for use on greenhouse crops. The proposed regulatory decision applies to the currently registered uses of quinoxyfen and, as such, does not include greenhouse uses.

Application of Virtual Elimination under the TSMP

Comment 31

An active ingredient that meets Track 1 TSMP classification is slated for 'virtual' elimination and not 'total' elimination as is proposed in PRD2018-01. There could be instances where the use of a Track 1 substance could be considered acceptable; however, DIR99-03 fails to provide examples and the PMRA appears to not be considering alternative options in lieu of canceling the registration of a pesticide.

Commenters suggested that many of the uses of quinoxyfen should qualify as critical needs or exemptions, given the value of resistance management and the standing investment in minor use projects for greenhouse uses.

Commenters also suggested that given very little quinoxyfen is used in Canada and risk mitigation measures (buffer zones, vegetative filter strips) are required on the label, environmental releases should be considered limited/minimized and this should have been considered in the TSMP assessment as meeting the goal of virtual elimination.

PMRA Response:

The PMRA's implementation is consistent with the Government of Canada's TSMP.

Under CEPA 1999, virtual elimination is defined as the reduction of the quantity or concentration of a toxic substance in releases to the environment to below a "level of quantification" specified by the Ministers. The level of quantification is the lowest concentration of a toxic substance that can be accurately measured using sensitive but routine sampling and analytical methods. This level is determined in a laboratory. The risk posed by the substance and socio-economic factors have no bearing in its determination.

When used as a pesticide, quinoxyfen is deliberately introduced into the environment at quantifiable rates. The PMRA does not agree with the commenter that the small amount used in Canada and the current risk mitigation measures be considered as meeting the risk management goals for Track 1 substances (i.e., virtual elimination). The deliberate release of a pesticide through application to agricultural fields is not in line with the definition of virtual elimination. The rationale and risk mitigation measures mentioned by the commenter (for example, limiting/minimizing environmental exposure and life cycle management) are examples of management goals used for Track 2 substances (i.e., substances that meet some, but not all TSMP criteria), not Track 1 substances.

Implementation of Virtual Elimination under CEPA and the *Pest Control Products Act*

Comment 32

The PMRA was requested to implement an appropriate and transparent go-forward process for the PMRA's application of the TSMP. The PMRA is encouraged to set maximum amounts to be released to allow the safe use of pesticides, in keeping with what ECCC has done for CMP.

PMRA Response:

The PMRA's approach to the TSMP is a go-forward process. For Track 1 substances, the PMRA prevents future environmental releases, but does not require the remediation of sites where quinoxyfen has been used in the past. A similar going forward approach is used under the Stockholm Convention.

Under CEPA 1999, virtual elimination is the reduction of the quantity or concentration of a toxic substance in releases to the environment to below a "level of quantification" specified by the Ministers.

When used as a pesticide, quinoxyfen is deliberately introduced into the environment at quantifiable rates. Therefore, the PMRA does not agree with the commenter that the small amount used in Canada and the current risk mitigation measures are in line with the risk management goals for Track 1 substances (i.e., virtual elimination). The risk mitigation measures mentioned by the commenter (e.g., limiting/minimizing environmental exposure and life cycle management) are examples of management goals used for Track 2 substances (i.e., substances that meet some, but not all TSMP criteria), not Track 1 substances.

Appendix II Revisions to the Text in PRD2018-01

Revisions to the Text in PRD2018-01

Based on the review of European Union field studies and considering its integration with the other information on persistence in soil previously reviewed, the following text in PRD2018-01should be updated:

Section: Environmental Considerations (p. 5)

No revisions are required.

Section 4.1 Environmental fate in soil (para 2, p. 9)

An aerobic biotransformation study was conducted with four different German soil types. Biotransformation of quinoxyfen in all soil types was slow and DT_{50} values were in the range of 324 to 459 days, following single-first-order kinetics. The major transformation products 2-oxo-quinoxyfen and DCHQ were observed, reaching maximum of 14.6 and 14.4% of the applied radioactivity, respectively, in one soil type. The results suggest that quinoxyfen has a great potential to be persistent in the field.

This study was conducted according to the most recent standards for laboratory studies of biotransformation in aerobic soils and is considered the most reliable compared to previous laboratory studies reviewed for quinoxyfen. Therefore, it should be considered in assessing quinoxyfen persistency.

Section 4.1 Environmental fate in soil (para 9, p. 10)

After reviewing these studies, it was concluded that none of the European TFD studies could be used to derive DT (dissipation time) values. In six of eight studies, quinoxyfen was applied on cropped fields followed by harvesting and replanting and could not be used to derive DT_{50} (dissipation time 50%, the dose required to observe a 50% decline in concentration) values. Although the two German field dissipation studies were conducted on bare soils, the study reports did not provide sufficient information to allow calculation of DT_{50}s. In particular, the application rates were not verified and no information could allow for conversion from measured soil concentration (mg a.i./kg soil) to application rate in g a.i./ha in soil profile. However, the fact that 1.5 to 2 years after a single application at 400 g a.i./ha (<2/3 of maximum Canadian application rate of 625 g a.i./ha), there were 26 to 33% of quinoxyfen remained in the German bare soil TFD sites and quantifiable residues remained in all cropped TFD fields provide supporting evidence that quinoxyfen is persistent under field conditions.

Although DT_{50} values cannot be derived, the PMRA concluded that there was sufficient evidence that significant amount of quinoxyfen was carried-over to the following growing season.

In the case of quinoxyfen, dissipation in the field cannot be confidently attributed solely to degradation. Abiotic and biotic degradation of quinoxyfen individual results from laboratory studies taken together, tend to indicate that quinoxyfen would be persistent in soil (is not volatile, does not hydrolyze, photolysis is not a major route of transformation). Under laboratory condition, 9/10 half-lives and the average of all half-lives reported for the aerobic biotransformation studies exceeded the persistence criteria.

Although the Ontario TFD study showed quinoxyfen dissipation rate does not meet the persistence criterion, the rate declined considerably over time. The shorter DT_{50}s did not show more degradation as the transformation products did not appear to be present at higher concentrations than in laboratory studies; it is therefore uncertain whether dissipation can be solely attributed to biotic and abiotic degradation processes. Furthermore, in the laboratory study using the same soil, quinoxyfen had an aerobic half-life of 263 days.

The European TFD studies reported in PRD2018-01 have been reviewed and found to be unacceptable for determining quantitative DT_{50} values. However, they all showed significant residues being carried over year-to-year. The other field studies (exposure monitoring and soil accumulation studies) also showed evidence of persistence and carryover year-to-year.

The PMRA concluded that except the Ontario TFD study, all the other field studies were either inconclusive or provided insufficient information to supersede the laboratory information. The PMRA cannot rely on a single TFD study to determine persistency of quinoxyfen in the terrestrial environment.

Section 6.1 Toxic Substances Management Policy Considerations (p. 15)

- Soil laboratory data clearly meet the TSMP Track 1 criterion for persistence. These studies also showed that the quinoxyfen degradation rate is strongly influenced by temperature.

- One TFD study conducted in Ontario showed that quinoxyfen was moderately persistent with a DT_{50} of 72 days.

- It was concluded that the DT_{50}s from the European field studies could not be properly calculated to characterize the degradation behaviour of quinoxyfen and did not provide sufficient evidence that quinoxyfen was not persistent.

- To assess the persistence criteria, field studies are traditionally preferred over laboratory studies, as they reflect more realistic conditions of use of a pesticide and consider all potential routes of transformation. However, the PMRA cannot confidently determine the persistence of quinoxyfen solely base on one TFD study. DT_{50} values derived from the laboratory data were preferred. The use of laboratory determined half-lives for persistence classification is in agreement with both the European Union and the United States Environmental Protection Agency.

- In monitoring/accumulation studies conducted over two to five years, considerable amounts of quinoxyfen were measured before yearly applications. Although DT_{50}s cannot be calculated for the field monitoring studies, the persistent behaviour was more consistent with observations from the field dissipation studies and the DT_{50} values from the soil laboratory studies.

Section 7.2 Environmental Risk

Appendix II

Table 3 Fate and Behaviour in the Environment

Study	Compound	Value	Remarks	Reference
Biotransformation				
Aerobic Soil	Quinoxyfen	For German Soils, 20°C, SFO: Loamy sand: DT_{50}: 459; DT_{90}: 1523 Sandy clay loam DT_{50}: 338; DT_{90}:1124 Sandy loam: DT_{50}324; DT_{90}:1077 Clay: DT_{50}370; DT_{90}:1230	Persistent	2873507
Field Dissipation	Quinoxyfen	***Applications to bare soil*** Southern Germany ***Applications to cropped soil*** UK and France DT_{50}s cannot be estimated. Significant carryover was observed.		2806711 2806709 2806714 2806708 2806713 2806710 2806707 2806712
Field monitoring over 2 years	Quinoxyfen	In the case of the 2-year European field and biota exposure studies, the magnitude of residues measured in the subsequent year, i.e. approximately one year apart, showed that quinoxyfen was relatively persistent in the German site as evidenced by very little decline in residues during this period (in some cases, close to100% carryover). In the Italian site, however, results were inconsistent at different monitoring locations and thus, is difficult to conclude on whether or not residues are accumulating over time.		1894307 1894309
Field monitoring over 5 years	Quinoxyfen	In the case of the soil accumulation studies, data were monitored during five		1771851 1771852 1771853

Study	Compound	Value	Remarks	Reference
		consecutive years of quinoxyfen use under operational field conditions in France, UK and Germany, where quinoxyfen was applied once or twice annually, in the spring or early summer. The magnitude of residues one week after treatment in the first year compared to that before treatment in subsequent year, i.e., approximately one year apart, are of most interest. At all sites, quinoxyfen appears to persist as evidenced by very little decline in residues in between applications and has significant carryover year-to-year.		

Table 6 Toxic Substances Management Policy Considerations for Quinoxyfen – Comparison to TSMP Track 1 Criteria

TSMP Track 1 Criteria	TSMP Track 1 Criterion Value	Quinoxyfen	Reference
Persistence[3]	Soil Half-life ≥ 182 days	<u>Laboratory Aerobic Soil Biotransformation</u> California sandy loam: 118 days (25°C) Ontario loam: 263 days (25°C)[6] German loamy sand: > 200 days (20°C) UK sandy clay loam: > 200 days (20°C) UK clay loam: > 200 days (20°C) UK sandy loam soils: > 200 days (20°C) German Loamy sand: 459 days (20°C) German Sandy clay loam: 338 days (20°C) German Sandy loam: 324 days (20°C) German Clay: 370 days (20°C) <u>Terrestrial Field Dissipation Studies relevant to Canada</u> ***Applications to bare soil*** S. Ontario loam: 72 days (DT90 = 287 days) <u>Additional information:</u> European TFD Studies: DT_{50}s cannot be estimated. Significant carryover was observed.	1642960 1771844 2873507 1667658 2806711 2806709 2806707 2806708 2806710 2806712 2806713 2806714

TSMP Track 1 Criteria	TSMP Track 1 Criterion Value	Quinoxyfen	Reference
		2-year exposure monitoring study: In the case of the 2-year European field and biota exposure studies , the magnitude of residues measured in the subsequent year, i.e. approximately one year apart, showed that quinoxyfen was relatively persistent in the German site as evidenced by very little decline in residues during this period (in some cases, close to 100% carryover). In the Italian site, however, results were inconsistent at different monitoring locations and thus, is difficult to conclude on whether or not residues are accumulating over time. 5-year accumulation study: In the case of the soil accumulation studies , data were monitored during five consecutive years of quinoxyfen use under operational field conditions in France, UK and Germany, where quinoxyfen was applied once or twice annually, in the spring or early summer. The magnitude of residues one week after treatment in the first year compared to that before treatment in subsequent year, i.e., approximately one year apart, are of most interest. At all sites, quinoxyfen appears to persist as evidenced by very little decline in residues in between applications and has significant carryover year-to-year. Overall, considering all the information obtained from the field TFD, monitoring and accumulation studies and based on the weight-of-evidence approach, the PMRA concluded that quinoxyfen is likely to persistent in soil.	1894307 1894309 1771851 1771852 1771853
[3] If the pesticide and/or the transformation product(s) meet the persistence criterion identified for one media (soil, water, sediment or air) then the criterion for persistence is considered to be met. [6] Reported in ERC2013-02 as 80th percentile DT50: 261.2 days.			

References

PMRA Document Number	Reference
2819912	2014, Quinoxyfen: Aquatic Food Chain Modelling in European Aquatic Ecosystems of a potentially bioaccumulative agricultural fungicide shows low risk to aquatic and terrestrial top consumers, DACO 8.5
2819913	2017, Bioconcentration and Bioaccumulation, DACO 8.6
2819914	2017, Quinoxyfen Environmetal Monitoring in the EU: A Correlation with Canadian Regions, DACO 8.6
2819915	2017, DAS Response to TSMP Assessment of Quinoxyfen, DACO 8.6
2873507	2013, Metabolism of [14C] Quinoxyfen in Aerobic Soil, 2012, DACO 8.2.3.4.2